

Particle emissions from animal husbandry – a new chapter for the Atmospheric Emission Inventories Guidebook

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Particle emissions from agriculture

Particles will be released from agricultural activities from

- plant production (see contribution by T. Hinz)
- **animal production**
- transport processes

The share of agriculture is likely to be in the order of 1 % of total particle emissions in Europe.

State of the art (1)

At a panel meeting in The Hague those institutions which had made inventories for particle emissions from agriculture met to discuss the state of knowledge:

- So far, no methodology was available in any Guidebook.
- Review of the literature: few useful publications
- Major information drawn from 1 publication only.

State of the art (2)

Takai et al. (1998) performed measurements for the major source categories in northwest Europe including

- dairy cattle (litter, cubicles)
- beef cattle (litter, slats)
- calves (litter, slats)

State of the art (3)

Takai et al. (1998) (contd.)

- weaners (slats)
- fattening pigs (litter, slats)
- sows (litter slats)
- laying hens (cages, perchery)
- broilers (litter)

State of the art (4)

Takai et al. (1998) (contd.)

Measurements were performed over at least one year, day and night, including free ventilation and forced ventilation systems.

Results were reported as inhalable and respirable dust related to livestock units.

Step 1

transfer of livestock units into animal numbers
using standard values

(e.g. dairy cow: 1.0, fattening pig 0.16, broiler 0.01)

Step 2

transfer of inhalable dust to PM_{10} (and respirable dust to $PM_{2.5}$)

using conversion factors by Seedorf & Hartung (2001) (cattle) and Louhelainen et al. (1987) (pigs).

For poultry, ID and RD were considered to be comparable to PM_{10} and $PM_{2.5}$

Step 3

Extrapolation to horses using a set of measured data and transferring cattle data

Step 4

Emissions of grazing animals are considered to be zero.

Resulting equation

$$E_{PM} = \sum_{ij} n_{ij} \cdot x_{t,i} \cdot EF_{PM,ij}$$

- $E_{PM, i}$ emission of PM from animal husbandry (in kg a⁻¹ PM)
- n_{ij} number of animal places in an animal category i according to the census (in places) in a housing type j
- $x_{t,i}$ time fraction, during which animals of category i are housed (in a a⁻¹)
- $EF_{PM,ij}$ emission factor for a given animal category i and housing type j (in kg place⁻¹ a⁻¹ PM)

Guidebook chapter on particle emissions from animal production

Resulting emission factors

Animal category	Housing type	Emission factor for PM ₁₀ kg animal ⁻¹ a ⁻¹	Emission factor for PM _{2.5} kg animal ⁻¹ a ⁻¹
Dairy cattle	Litter	0.36	0.23
	Cubicles	0.70	0.45
Beef cattle	Litter	0.24	0.16
	Slats	0.32	0.21
Calves	Litter	0.16	0.10
	Slats	0.15	0.10
Sows	Litter	0.58	0.094
	Slats	0.45	0.073
Weaners	Litter	n.a.	n.a.
	Slats	0.18	0.029
Fattening pigs	Litter	0.50	0.081
	Slats	0.42	0.069
Horses	Litter ¹⁾	0.18	0.12
Laying hens	Cages	0.017	0.0021
	Perchery	0.27	0.052
Broilers	Litter	0.35	0.045

Comparison

- emission factors are similar to those used by IIASA

Limitations

- limited original data set
- data source not representative of the UNECE area
- transfer factors “soft“

Therefore: Method to be called “First estimate” rather than “simpler methodology”

Procedure

- Guidebook chapter will be discussed at the Agriculture Panel meeting (this week)
- missing references etc. will be checked
- chapter will be sent to Task Force in November who will make it available to the public
- comments by the public will be incorporated at the Panel's intermediate meeting
- final version will be presented to the Task Force